[0124] FIG. **18** shows an enhanced antiresonant design of the device according to another mode of realization of the invention and using a top Bragg mirror over the microcavity.

DETAILED DESCRIPTION OF THE INVENTION

[0125] With reference to FIG. **1**, we will describe a general mode of realization of the invention which allows manufacturing laser devices in the form of compact and stable laser modules.

[0126] The laser device comprises a semiconductor element **10**. This semiconductor element **10** is mounted on a heat sink **15** with Peltier elements for stabilizing and controlling the temperature.

[0127] The semiconductor element **10** comprises a succession of layers grown by epitaxy.

[0128] These layers comprise:

- [0129] a base substrate **11** (either native or host substrate),
- [0130] a first high-reflectivity Bragg mirror **12**,
- [0131] a gain region **13** with the quantum wells,
- [0132] an exit region **14** with a protective layer.

[0133] The laser device further comprises a second mirror **16** of a concave shape which forms with the first mirror **12** an external optical cavity. That second mirror **16** has a few percent of transmittance so as to allow the laser beam **21** to exit the laser.

[0134] With reference to FIG. **2**, the second mirror **16** is mounted on a high stability mechanical mount **17**. The mount **17** is equipped with a piezoelectric actuator **22** which allows moving the second mirror **16** relative to the semiconductor element **10** so as to vary the length of the external cavity.

[0135] The mount **17** further comprises a flexible part **23** that is elongated by the piezo-electric actuator **22**.

[0136] The mount **17**, which is globally of a U shape, holds also the semiconductor element **10**. This set-up is a key element to improve the stability of the cavity and get a stable operation of the laser.

[0137] The laser device further comprises a continuous, linearly polarized multimode laser diode **18** with beam shaping optics **19** for generating an optical pump beam **20**.

[0138] The assembly is arranged so that the pump beam **20** is incident on the exit region **14** of the semiconductor element at the Brewster angle, so as to have a maximum of coupling into the gain region **13**.

[0139] The first high-reflectivity Bragg mirror **12** is of course reflective for the laser wavelength. It may be also reflective, or partially or totally transparent for the pump wavelength.

[0140] The elements comprised in the exit region **14** as described below are partially or totally transparent for the pump wavelength.

[0141] The device of the invention further comprises stabilization means for stabilizing the intensity of the pump beam **20**. These stabilization means comprise a wide-band low-noise photodetection system (comprising a photodiode located on the back side of the laser diode **18** and a low noise amplifier) for measuring the intensity noise of the pump beam **20**, a low noise high current wide-modulation-band driver for driving the pump laser diode **18**, and a wide-band control loop so as to cancel the intensity noise.

[0142] The noise reduction may be then limited only by the partition noise (that is the noise due to the relative variations of amplitude of the modes), and can lead—for example—to noise reduction down to −160 dB/Hz at low frequencies (<100 kHz) for 1 mA (<<1%) detected by the photodiode. The overall system benefits then of low 1/f noise in multimode pumps and low 1/f noise in the low frequency transimpedance circuit conditioning the photodiode signal, combined to a strong integrator gain stage in the servo-loop.

[0143] The external optical cavity is called "external" in the sense that it comprises a part which is distinct from the semiconductor element **10**. In does not need any extra component inside for the proper operation of the laser. Its external part is filled with air.

[0144] The device allows easy adjustment of the laser frequency by moving the second mirror **16** with the piezo actuator **23** so as to vary the length of the external cavity.

[0145] The laser frequency may also be varied by varying the temperature of the semiconductor element **10** with the Peltier elements of the heat sink **15**.

[0146] The present invention aims at providing different laser design that leads to single frequency, high power and fast tunable over a broad frequency range, with tuning repetition rate up to few MHz. Such lasers are obtained thanks to some parameters that have to be carefully adapted in order to reach those performances:

- [0147] a short external cavity, whose length is preferably comprised between 0.2 mm and 2 mm, and/or
- [0148] a high finesse, typically higher than 100, and preferably higher than 600, in order to reduce optical losses onto the first and the second mirror, and reduce the laser cavity cutoff RF frequency (FSR×losses/2R) for the intensity fluctuations, at a value below 1 GHz of great interest for telecom, opto-hyper, or fundamental applications and/or
- [0149] optical losses smaller than 1% over a round-trip inside the cavity, and/or
- [0150] a thermal lens impact reduced thanks to a ratio between the light power inside the optical microcavity and the light power inside the external cavity lower than or equal to 1, typically in the range of 0.1 to 0.9, and/or
- [0151] a spectral ratio between the Half Width Half Maximum (HWHM) spectral bandwidth of the modal gain and the free spectral range of the optical microcavity and the external cavity in the range of 2 to 50 in order to provide a robust single frequency emission with a generation time in the order of the microsecond.

[0152] A possible design for single frequency operation, is to use a long cavity that is much more longer than 1 mm instead of a short cavity for long photon life time (lower laser cutoff frequency of intensity fluctuations, lower frequency noise), allowing reduction of the finesse, to the detriment of spectral tuning repetition rate and achievable range.

[0153] The semiconductor element is based on a GaAs substrate.

[0154] It comprises a high-reflectivity Bragg mirror 12 with 31.5 pairs **30** of AlAs/GaAs layers of $\lambda/4$ thickness each (λ=1000 nm), or in other words 32 layers of AlAs alternating with 31 layers of GaAs.

[0155] The active region or the gain region **13** is mainly made of GaAs, and has a thickness of 13 $\times\lambda/2$ (λ=1000 nm). It comprises six quantum wells **31** made of $GaAsP_{0.06}$/InGaAs/$GaAsP_{00.6}$ layers emitting at ~980 nm at low exci-